DIRECTIONS

FOR THE USE OF

SHIP-MASTERS NAVIGATING IN THE SOUTH PACIFIC

OR

ON THE QUEENSLAND COAST.

BY J. D. SWITZER, R.N.,
GOVERNMENT ADJUSTER OF COMPASSES.

BRISBANE:
BY AUTHORITY: JAMES C. BEAL, GOVERNMENT PRINTER, WILLIAM STREET.

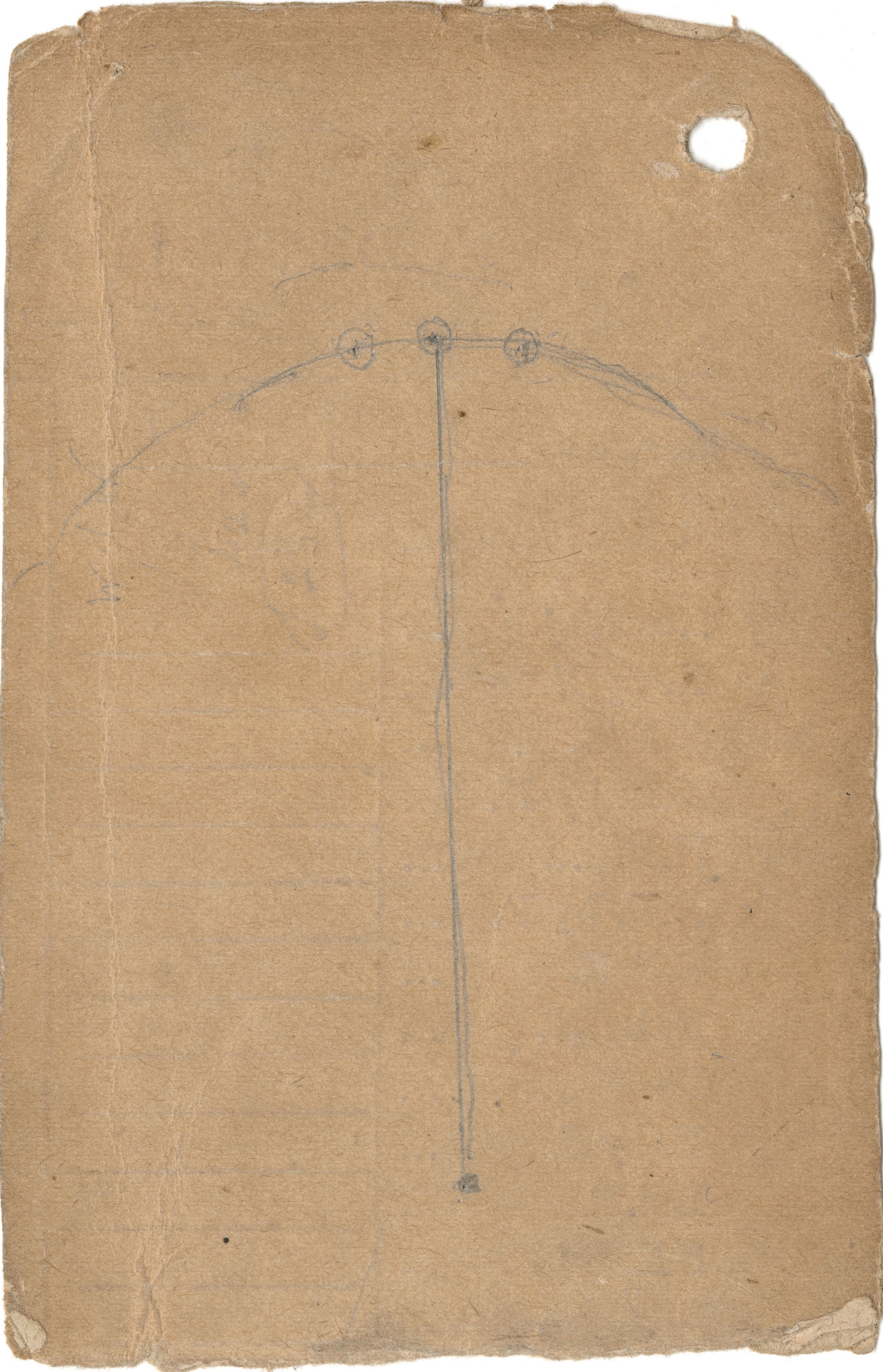
1889.

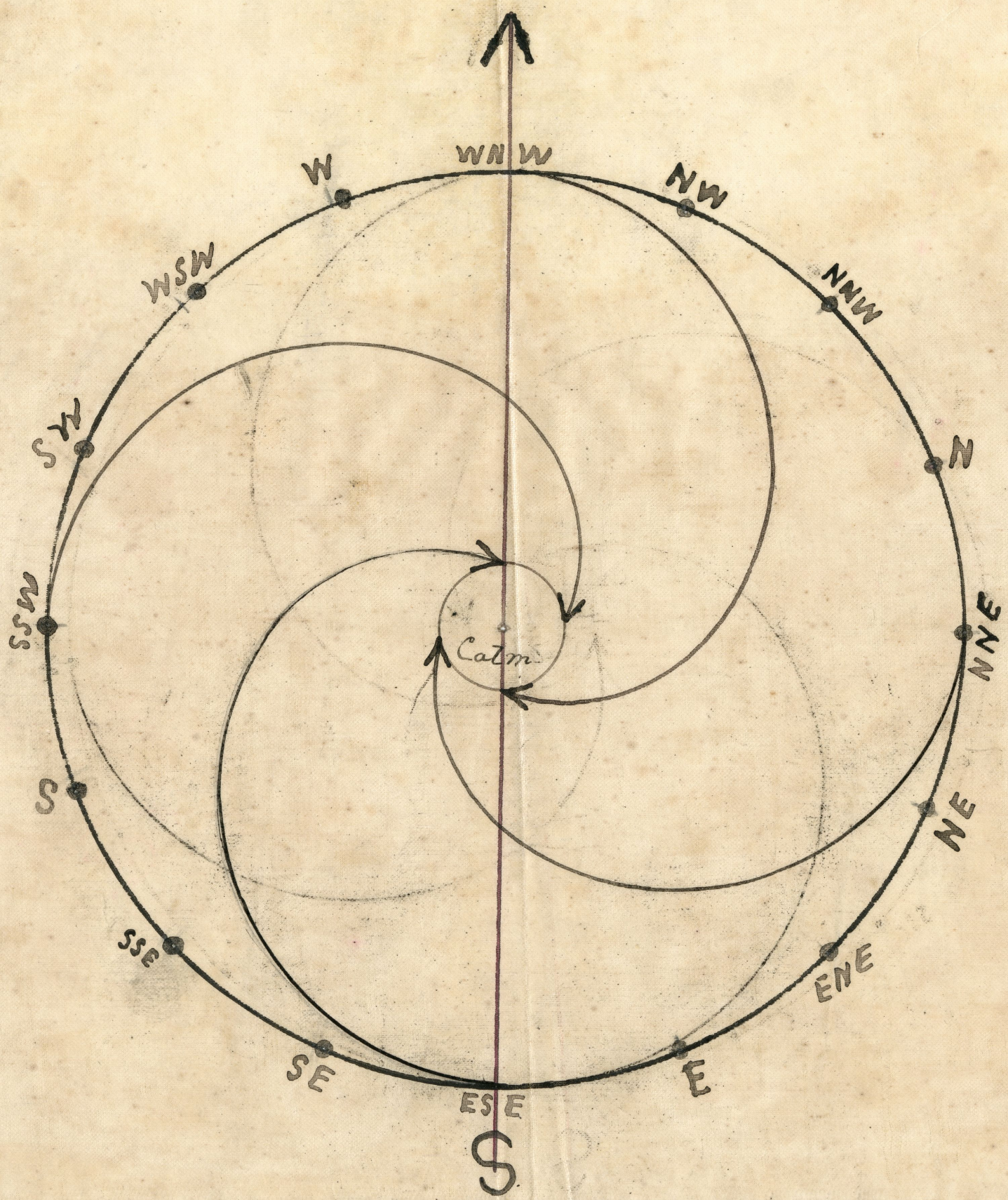
No 1

DEVIATION

SHIP'S HEAD

SHIP'S HEAD by Compass	~~CORRECT MAGNETIC~~	DEVIATION.
North ...		1 East
N. by E. ...		8 "
N.N.E. ...		9 "
N.E. by N. ...		11 "
N.E.		13 "
N.E. by E. ...		15 "
E.N.E. ...		18 "
E. by N. ...		20 "
East		22 "
E. by S. ...		24 "
E.S.E. ...		25 "
S.E. by E. ...		25 "
S.E.		24 "




W
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S
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CYCLONE DIAGRAM Pacific Ocean, South

From end of December to middle of April

Shaded Semicircles shew advancing part of Storm, or that part of it which a sailing vessel must encounter first

Arrows passing through, shew the general track of the Storm over the Ocean surface and the average Latitude and Longitude in which they recurve to the S.E.

Arrows on largest circle, shew the indraft or spiral motion of the wind, this indraft is always greatest in the commencement and depends on the speed of revolution, i.e. the greater the speed, the more the indraft.

Directions, outside the circles, shew what a vessel ought to do, in the respective positions, whenever there is sea room, also the undoubted necessity of using a Sea Anchor supplemented by an oil bag. N.B a sailing vessel cannot as a rule do anything before the outside of the gale reaches her, a calm is nearly always in front, but a Cyclone can invariably be avoided by a steamer.

The vortex or centre of those Storms is by far the most dangerous part.

No vessel whether Sailing or Steam being manageable when through ignorance or foolhardiness she is allowed to be involved so far, the sea assumes much the appearance of boiling water, pinnacle shaped waves dash with great violence against each other and come on board a ship in 2 or 3 places at the same moment.

Progressive motion increases with the Storm area, until recurving when a sudden expansion takes place, With the revolving motion the opposite rule holds good.

Premonitory Signs

(1) High Barometer
(2) Unusual brightness of Stars.
(3) Heavy swell in Calm weather.
(4) Threatening Sunrise or Sunset.
(5) Greenish tint in clouds.
(6) Heavy arched bank of clouds and irregular gusts of wind.

When inside the Tropics, and the wind is not more Northerly than E.N.E. it is advisable to run with wind on Port Quarter if the Barometer does not fall while so doing, but if on the contrary it falls, lay Ship to on Port tack to allow the Storm to pass by to the Westward.

As the Sea moves away from the Storm radially its direction affords a sure guide as to the direction of the Storm Centre.

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CYCLONE DIAGRAM, SOUTHERN PACIFIC.

Shaded Semicircles show advancing half, or that part which a sailing vessel *must* first meet.

Bent Arrows show indraft of wind towards centre, a warning to keep ship's head away from storm centre.

On the inside of eliptical storm track, ships cannot show any canvas; on the outside they can carry canvas, because in the former position the forces are revolving + progressive, on the latter they are revolving — progressive, which means a difference of force varying from $\frac{1}{2}$ to $\frac{1}{8}$.

The outer edge of cyclone consists of irregular gusts of wind, and before the gale closes too much all top hamper should be sent down from aloft. If a sea anchor and an oil bag be used when laying to, a ship may ride out the heaviest gale in comparative safety, when there is sea room.

When the storm is at some distance and the sea comes from the N.E., the storm has not recurved; if from the Northward, it is recurving; if from N.W., it has recurved. These signs when taken in conjunction with the bearing of storm centre and the ship's geographical position will enable a ship-master to decide that most important subject, the progressing direction of the cyclone.

When amongst the islands, with a hurricane threatening, always try to get to the westward of one of them, because a ship will always drift to the westward in the first part of the gale further than she will be set by the easterly drift after the storm centre has passed, and therefore she cannot go on shore.

When inside the Barrier Reef or close to the eastern coast north of Point Danger and the cloud bank is to the southward, stop for a few hours and let the storm pass away to the southward. Inside the shoals and reefs the size or direction of the sea is not of any use as a guide, but the barometer is; therefore, in the summer months do not come south with a rapidly falling glass.

When inside the Reef and the cloud bank bears northerly, there is but one alternative for a steam vessel—either steam South for the nearest shelter, or try and stem the gale, head off the land: a sailing vessel has no alternative—she must stand to the southward and eastward while she can carry canvas.

A sailing vessel could not get into the unshaded, or following half of storm, without passing through some part of the shaded—that is, she must first get the wind (storm not recurved) between E.N.E. round by South to S.W. (storm recurving), from North round by East to South (storm recurved), from N.W. round by North to East; but a steam vessel might overtake a cyclone. By careful attention to the barometer she would be able to pass round the storm and convert it from a source of danger into a practical advantage.

The wet and dry bulb thermometers, when constantly registered, are a great help in foretelling the nature of a coming storm. Their difference falls to 2° or less, in front of a cyclone.

CYCLONES IN THE SOUTH PACIFIC.

THERE are two methods by which a knowledge of the motions of these storms can be ascertained—one by observations taken on shore, the other by comparing the logs of ships which may have been involved in one particular storm. As in every other investigation into motions over considerable distances, so in this also, the construction of a diagram for each case is by far the simplest way in which the knowledge required can be conveyed. The first part of this pamphlet consists of *all the accessible data connected with some Cyclones which have blown home on the Queensland Coast.* The second and last part, of information obtained from the logs of vessels which have been involved in hurricanes in the South Pacific Ocean.

The first case is that of a cyclone passing over the Bundaberg district in 1873, observed by the writer. The previous night was distinguished by an unusual brightness of the stars, and sunrise by an ominous threatening appearance—a greenish tint in the upper strata of air, and a bank of dense black clouds in the N.E. Knowing from former experience what was coming, preparations were made for removal into the scrub close at hand. At 8·30 a.m. the previous calm was disturbed by a succession of irregular gusts of wind with heavy rain, the barometer, which had been up to 30·12 the previous evening, being now at 29·80, and falling fast. At 9·15 a.m. the true outer edge of the cyclone arrived with a force of 10 or 11, and from the latter time until 0·15 p.m. continued to increase, when it suddenly ceased and the Bar dropped $\frac{2}{10}$. The sun came out and showed a halo round it and the sky was blue—this lasted fifteen or twenty minutes, during which time a retreat was made to the scrub ; it then commenced to blow in furious gusts and with irresistible force, gradually decreasing and becoming more regular, with a rapidly rising barometer until 2·45, when the sun came out and the wind dropped nearly to a calm. During this gale, particularly towards the middle, all descriptions of trees were uprooted, branches broken off and whirled almost perpendicularly into the air, cattle and horses were unable to stand and were obliged to lie down to avoid being blown about: the centre had evidently passed over the observer. In Bundaberg town the gale was felt, force 10 to 12, the wind varying regularly from N.E. to N.W. The centre of the storm passed in on the land over Baffle Creek about 9 a.m. and from there took about three hours to travel thirty miles, or at the rate of ten miles an hour. The first of the gale at the observer's place (twenty-four miles up the river) blew S.E. by S., continued steady until the centre arrived, and resumed its violence after a quarter of an hour from the N.N.W. By allowing the storm a radius of from fifteen to twenty miles, making a diagram with a right-handed vortical curve and with a two-mile central calm, placing it on a local chart of the same scale, it can be seen beyond dispute, that this cyclone had a progressive motion of eight or ten miles an hour to the S.W., and a revolving motion in the same direction

as the hands of a watch. The writer has had on three occasions the most favourable opportunity of observing waterspouts at sea, and has noted that south of the equator every one of them had similar motions; that during formation they were almost stationary, and afterwards when the rotatory motion was well established they began a movement to the westward. Taking this with the invariable westerly motion of hurricanes in both tropics, one can readily understand the suggestion and inference, that they are all gigantic waterspouts which have lost a portion of their violence by enlargement and friction against the surrounding medium; that the westerly motion is set up by the loss of gravity action on the rapidly revolving body of air and water, and the earth's surface motion on its axis from west to east leaves them behind. The cause of hurricanes revolving right-handed in the southern and left-handed in the northern hemispheres is stated by some writers to be the edges of the westerly equatorial air currents coming into frictional contact with the easterly moving edges of the trade winds. The beginning of hurricane seasons very nearly agrees with the greatest sun declination or midsummer day in each hemisphere.

The following condensed extract from the "Geelong's" official log is given in order that an independent opinion may be formed by each person:—

16-2-88.—In Whitsunday Passage.
0·20 a.m.—Strong squalls and threatening from S.E.
9·20 a.m.—Wind increasing and becoming non-intermittent.
3·20 p.m.—Furious gale and heavy rain, with rapidly falling barometer.
5·0 p.m.—Anchored in Maryport Bay.

17-2-88, Midnight.—Increasing gale from S.E.; barometer falling; riding with both anchors down, and steaming occasionally.
4·0 a.m.—Wind blowing with hurricane force.
5·15 a.m.—Rain cleared enough to observe the land astern within a cable's length, the wind having veered from S. to N.W., and, being on a dead lee shore, run the vessel on the sandy beach in order to avoid breaking up on the rocks and to save life.

This cyclone gave any amount of warning, and when the first of the gale was found to be from the S.E. the ship should have been steered to the northward until clear of the passage, and then a course shaped so as to get to the westward until the barometer rose half an inch. The course taken brought the vessel in extreme risk of being caught in the vortex, and although she escaped this, she was lost.

The westerly progress of this cyclone was stopped by the high land of Whitsunday Island, and particularly by the mountains on the mainland side of the passage. It commenced also to break up and become irregular in detached portions, the main body and centre passing to the eastward or outside the large island and over the Beverley Group; the eastern part of the latter passing over the

Percys, the western edge over Flat Top. It then began to change fast to a S.E. course, the S.W. edge going over Sandy Cape, and the centre over Capricorn Channel; one portion, disrupted and partially altered in cyclonic character, passed over Cape Capricorn and Bustard Head. By placing the diagram over the chart, and referring to the times of lowest barometer, one can trace the track, speed, and gradual enlargement of this storm, bearing in mind the direction of the wind at each Lighthouse, viz.:—Cairns, light winds and fine; same at Townsville; Bowen, strong winds and cloudy from S.W.; Dent Island, hurricane force, wind veering from S.E. round by S. to S.W.; Flat Top, hurricane force, wind veering the same, but not lasting so long; Broadsound, heavy gale S. to S.W.; Sandy Cape and Lady Elliott's Island, very heavy gale veering E. to S. in the latter, and E. to E.S.E. in the former. Times of lowest barometer, or centre passing:—Dent Island, 17th, at noon; Flat Top, 17th, 9·0 p.m.; Broadsound, 18th, 9·0 a.m.; Pine Island, 18th, 2·0 a.m.; Lady Elliott's, 18th, 3·0 p.m.; Sandy Cape, 18th, 8·0 p.m. These data give demonstration of the circular and local character of the gale, for if the wind blew in a straight course it would have reached Cape Moreton (where nothing but a heavy swell was felt) in a few hours after contact with Whitsunday Island. The You Yangs was also in this gale and very nearly lost by anchoring in the Beverley Group when she should have proceeded on with the intention of getting to the northward of the storm, every minute in such direction conducing to her safety. It was fortunate that the commander of the vessel felt it necessary to slip his cables and run, else he would have been involved in the storm centre and found himself on a lee shore after it had passed—the most hopeless position of all.

The barometer began to fall fast south of this group, and close to it, when the storm centre was abreast of Whitsunday Island, from which we may get an estimate of its meridional diameter (which must by pressure on the land have become elongated), about seventy or eighty miles; the progressive speed increasing from two to eight miles per hour.

The hurricane which wrecked Bowen on the 30th January, 1884, affords a proof of the statement that circular storms are of comparatively small dimensions on their arrival on this coast, and very seldom pass in over the land where there are high hills, but recurve on contact and break up also on the edges. It came from the E.N.E., the outer part of the southern edge not reaching Dent Island; the centre bore north at 6 a.m. on the 30th there, and three hours later the centre passed close to Bowen; at 1 p.m. at Cape Bowling Green it blew from S.W. to W. hurricane force; Townsville was outside its influence, but Flat Top, Broadsound, Lady Elliott's, and Sandy Cape had heavy gales with rain and very high swell. The place of recurvature was at or near Bowen, thus accounting for the length of time it took in passing by, as well as for the localised severity. This meteor broke up among the high hills at the back of the town, and then passed away in detached portions to the S.E., or on the usual track.

Many persons may remember the "Doon," barque, coming in dismasted after a short absence from Brisbane on her home voyage. The master ridiculed the idea of circular storms, and when, within a few days' sail of New Caledonia, he got into threatening weather from the eastward he hove the vessel to, head North, as a matter of course he

became involved in the centre, had to cut away his masts, and escaped ship-foundering by a very narrow margin.

The "Lochiel" also got into the very same position by running before the southern edge of a hurricane with a falling barometer, whereas the "Jessie Kelly," belonging to the same owners, and only seventy-five miles to the N.W. at the time, by wearing ship every four hours kept out of the danger. Both of the former vessels should have been laid to on the port tack and let the cyclone pass by. The commander of one of the China steam boats, to whom I had the pleasure of talking on this important subject, and to whom I gave diagrams for use at sea, informed me about nine months afterwards that he was steaming south into dirty-looking weather with one of the most powerful of the P. and O. mail boats in company, and kept on longer than he otherwise would because the P. and O. steamer continued; finding the weather getting worse every moment, he bore up (rather too late) N.W., and got on the northern edge and then round the eastern. By remaining too long he had almost a hurricane force to contend with and lost two boats. The P. and O., mail boat, which continued going south, arrived a complete wreck at Singapore, the repairs done to the hull alone amounting to £18,000.

Two large barques which sailed from Brisbane to San Francisco, and whose commanders determined to give my advice a fair trial, wrote to me on their arrival thanking me for my kindness (they said), and stated that they had both got into hurricanes on their passages, had followed out rules founded on the spiral theory, and by so doing had escaped without the slightest loss.

If the masters of vessels would keep careful hourly records of the changes that occur whenever their ships may get into one of those circular gales, and forward them to the Portmaster, they would confer a boon on the mercantile community, by enabling those storms to be further investigated.

The number of circular storms which have been reported this season, coupled with the loss of many sailing vessels, has induced the writer to place this paper before Captain Heath, R.N., for his consideration, so that if he approves thereof, the seamen of Australia may have the benefit of from twenty to thirty years' study and considerable practical experience by its general distribution.

The preceding data have been given and the remarks written to enable each one to trace out for himself the combined rotatory and progressive motions of cyclones in the South Pacific; those that follow are merely theoretical, but are appended in the hope that they will prove interesting to those who wish to go below the surface and know something of the natural laws governing the movements of the atmosphere in those storms.

(1.) *Their Origin*.—Waterspouts occur in great numbers within the Tropics, particularly after there have been an unusual amount of cold winds from the South Pole in the preceding spring. Cyclones are evidently gigantic waterspouts from their similarity of motion: the former have been seen in the act of formation and disruption, but an occasional one increases in size by absorbing the surrounding air, and thus from a diameter of a few hundred yards extend in some well-known cases to 500 miles.

(2.) *Their Motions*.—When a body is in a state of rapid rotation the action of gravity becomes considerably modified—that is, concen-

trated in the lower axis. This can be easily proved by a spinning top on a sheet of tracing cloth. If the latter is smartly moved the top will lag behind, and when the cloth ceases to be moved will be found to be in an intermediate position on the board underneath. Applying this known law to a revolving portion of air over water, taking the earth's speed of revolution at their birthplace, in or about 8° south latitude, at 891 miles per hour from West to East, it becomes a highly probable hypothesis that therein lies the cause of circular storms having a progressive motion over the surface from East to West. A glance at a chart of the World on which the Hurricane tracks are marked shows that they invariably recurve when opposed to high land, and that where the coast is low they pass in over it and get broken up among the first mountains they encounter—as on the Florida and Mississippi coasts: the resistance of the land is assisted by the compressed state of the air in front of the storm. The gradual decrease in revolving speed with increase of diameter is easily accounted for by friction on surrounding atmosphere acting as a brake, and by the power lost in overcoming its inertia. The foregoing is rendered doubly probable when it is known that cyclones are flat discs not more than 1½ miles in height.

Those reasons also—if allowed due weight—will account for the apparent contradiction involved in the indisputable fact of an increase of speed of revolution as the centre is approached, and also for the vortical indraft so conspicuous in those storms before recurvature.

Between the limits of the Trade winds there is a Westerly equatorial air current: it has been suggested that the contact of those opposing forces is the cause of not only the rotation of those storms, but also of the invariable direction of that motion, viz., left-handed in the Northern and right-handed in the Southern Hemispheres.

There remains only to account for the calm central space accompanied by blue sky and sunshine in circular storms, and as it is the most disputed and difficult point to deal with, and at the same time of least consequence to the seaman, a few words will suffice. There must be either a down or uprush of air as there is no horizontal motion. The writer believes in the uprush for the following reasons:—In the centre there is generally, if not always, a sudden drop of the barometer, showing an equally sudden diminution of pressure; the clear blue sky, the pinnacle shape of the waves, all tend to prove the uprush, for if there was a down-rush, the barometer would rise from pressure and the rain would fall in waves instead of drops. The advocates of the down-rush depend their argument solely on the alleged fall of the thermometer, which can be accounted for by the absence of atmospheric friction and consequent lowering of temperature. The most natural way, and the one which accords best with known laws is, that of a rapid ascension of saturated air becoming condensed in the upper part of the centre, and then falling over in the shape of an umbrella, for such is the form of the cloud banks of which hurricanes are composed.

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